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the shadow will be cast into the fog and appear gigantic. This is probably an explanation of the 'pseudo-aurora.'

H. A. HAZEN.

JANUARY 29, 1897.

[The above letter entirely mistakes the point of Goode's explanation of the pseudo-aurora. The fact that the electric lights have shields above them, which cut off vertical rays, as stated by Hazen, is irrelevant; for Goode does not think that the apparently vertical pseudo-auroral rays are really vertical; but that they are due to oblique rays emitted from the light at various angles of inclination, and reflected from under surface of horizontal snow plates, so that the locus of the reflection stands in a vertical plane through the observer, and the light wherever the observer is; hence the subjective impression that the ray is really a vertical beam of light. There is no analogy between these apparently vertical illuminated rays and the true dark shadows mentioned by Hazen.—ED. SCIENCE.]

GREENLAND GLACIERS.

TO THE EDITOR OF SCIENCE: The angular and apparently unglaciated peaks in Greenland mentioned by Professor Tarr in your issue of to-day are represented in Pennsylvania by similarly angular ridges covered by angular and local débris. It seems that advancing ice has no power to surmount a moderately sharp slope, but masses at its base and accumulates till the summit is reached, when a thrust plane is developed in the glacier above which the moving mass proceeds across the summit. This has been noted by the writer (*Am. Jour. Sci.*, March, 1895, p. 181) at Bethlehem and in Mifflin township. Since the publication of the above other instances have been found which show that the glacier pours into a valley and fills it, or masses against a steep, opposing slope, develops the shear and remains practically stagnant below the thrust plane, or would remain so were it not for its ablation and the erosion due to subglacial torrents, which cause it to settle down the slope and down the valley trough, and thus become an accentuated creep which strews the valley with local fragments from the summit. The constantly forming

sub-glacial void, due to the causes just stated, induces a downward movement in the ice above the thrust plane, and the crest of the ridge is frequently found crushed by vertical forces. In the Mahanoy region the vertical outcrop of hard sandstone is thus crushed flat to a depth of ten feet on the crest, and bent to north on the northern slope and to the south on the opposite side. This is but one instance where valleys have been glaciated while the summits of the ridges remain angular, and the fact that there is always difficulty in tracing moraine lines over ridges may be accounted for by the fact that ridge deposits are not allowed to remain *in situ* but creep down the slopes to the valley troughs. The finding of angular ridges or peaks, therefore, is, as Professor Tarr states, no sign of the absence of ice from the locality.

EDWARD H. WILLIAMS, JR.

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SCIENTIFIC LITERATURE.

L' evolution de l' esclavage. Par CH. LETOURNEAU. Paris, Vigot Frères. 1897. 1 vol. 8vo. Pp. 538.

It is a sad fact, emphasized by Professor Letourneau, that in all times and places most of the work of the world has been imposed upon the minority of the inhabitants. In old times, and in some places to-day, this was accomplished by the simple means of brute force, reducing the conquered and the feeble to the condition of slavery. The development of this tendency in the past, and its possible future effects, are the theme of the work before us.

It begins with the lower species, pointing out that in the societies of ants and termites there are slaves and servile revolts, quite like those in human history. Among men of the inferior races—and not these only—the regular slave is the woman. In many of the negro peoples she is literally a beast of burden, and is rated no higher than one. The women are bought and sold; they are given away and, when incapable of further profitable labor, are killed and eaten, or turned out to starve.

The long list of examples of this character collected by our author leaves a disagreeable sense of the meanness and baseness of masculine

nature. It inevitably led, as he points out, to a degeneration both of the slave and the master, both of the woman and the man, and destroyed the possibility of any notable progress in civilization.

In the chapter on slavery among the American aborigines he adduces a few examples, but recognizes that it was not a prevalent institution with the red race. The gynocracy found in some tribes, he explains as merely apparent, not a real government, but confined to industrial aims. On the slaves of Mexico and Peru, he is somewhat full, but confines himself to second-hand authorities and not always the best of these.

From America he passes to the Polynesians and the Mongolians, where the condition of the enslaved classes was as wretched as anywhere. Turning to ancient history, he collects from classical authorities a mass of information on slavery among the Semites, the Egyptians, the Greeks and the Romans. Of course, on the latter he is particularly ample, as the sources of accurate knowledge are abundant. Everywhere he finds the same characteristics evolving in like social environments.

The semi-servile conditions in the Middle Ages, such as those of the serfs, the adscriptus of the glebe, and the like feudal dispositions of the lower classes, occupy an instructive chapter.

Finally, the author applies himself to the practical application of his long study of enforced labor. How is it to be avoided? Or so modified as to distribute even taxes on all? To this he devotes his closing pages; but they are too vague, too visionary, too remote from any possible immediate adoption, to satisfy the earnest reader. Slavery, in its ancient forms, is practically extinct; but is not modern freedom, in the face of labor unions on the one hand and monopolies on the other, just what Dr. Johnson defined it a hundred years ago and more, freedom to work or starve? An excellent index closes the volume.

D. G. BRINTON.

The Geological and Natural History Survey of Minnesota. N. H. WINCHELL, State Geologist. 1892-1896. The Geology of Minnesota, Vol. III. Part II. of the Final Report. Pale-

ontology, by E. O. Ulrich, John M. Clarke, Wilbur H. Scofield, and N. H. Winchell. 4to. Minneapolis, 1897. Pp. lxxxiii. to cliv., 475-1081, plates 35-82, and 133 figures in the text.

The introductory chapter by N. H. Winchell and E. O. Ulrich gives a detailed correlation of the Lower Silurian deposits of the Upper Mississippi province, with those in the Cincinnati, Tennessee, New York, and Canadian provinces, together with the stratigraphic and geographic distribution of the fossils. It is doubtful whether any State Survey has ever before attempted so successfully such a minute study and correlation of the beds and horizons of an extensive series of sediments. It shows a vast amount of careful and intelligent collecting. This kind of work has made possible the preparation of the succeeding excellent chapters on various classes of fossil remains from the Lower Silurian or Ordovician.

E. O. Ulrich, under separate chapters, treats of the Lamellibranchiata and Ostracoda. These classes of animals are generally recognized as difficult to deal with in the fossil state, the former from the common imperfection of preservation, and the latter from their minute size and simple form. The paleozoic lamellibranchs are arranged under twenty-nine families, of which ten will include all or nearly all of the Ordovician genera.

The Trilobites are described by J. M. Clarke, in Chapter VIII. The material is not so rich as in some of the other classes, but is thoroughly elaborated. Valuable sections are added dealing with the American Lower Silurian Phacopidae, and the subordinate generic relations of the species of the genera *Ceraurus* and *Lichas*. Chapter IX. on the Cephalopoda is by the same author. About fifty species are noticed, including the novel primitive nautiloid type, *Nanno*, about which there has already been considerable discussion in America, England and Sweden.

The final chapter (X.) on the Gastropoda, by E. O. Ulrich and the late W. H. Scofield, occupies more than one-third of the volume. Numerous new genera and species are described and illustrated, showing the richness and variety of this fauna.

C. E. BEECHER.